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PUB-NO: JP02000186718A
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TITLE: CROSS ROLLER BEARING AND WAVE GEAR DEVICE UNIT

PUBN-DATE: July 4, 2000

INVENTOR-INFORMATION:
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HARMONIC DRIVE SYST IND CO LTD

APPL-NO: JP10363912
APPL-DATE: December 22, 1998

INT-CL (IPC): F16 C 19/36; F16 H 1/32

ABSTRACT:

PROBLEM TO BE SOLVED: To provide a small-sized, compact, and very light wave gear device unit.

SOLUTION: In this wave gear device unit 1, a wave gear device 5 of silk hat shape is embedded between a first end plate 2 and a second end plate 3, and a rigid inner gear 51 and a flexible outer gear 52 of the wave gear device 5 are connected to each other via a cross roller bearing 4 so as to be capable of relative rotation. An outer wheel 41 of the cross roller bearing is a composite part comprised of an outer wheel body member 411 of light alloy and an outer wheel side raceway surface forming member 412 made of iron based material and connected to an inside of the outer wheel body member 411. An inner wheel 42 is also a composite part comprised of an inner wheel body member 421 of light alloy and an inner wheel side raceway surface forming member 422 made of iron based material and connected to an outside of the inner wheel body member 421. By this constitution, the considerably light wave gear device unit can be realized.



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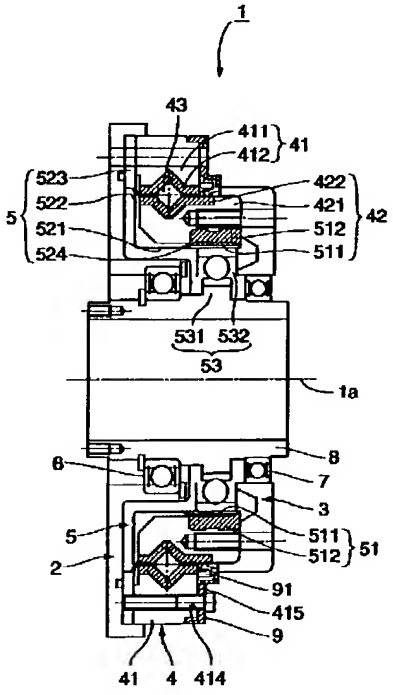
(54)【発明の名称】　クロスローラベアリングおよび波動歯車装置ユニット

(57)【要約】
【課題】　小型、コンパクトであると共に非常に軽量な波動歯車装置ユニットを提案すること。
【解決手段】　波動歯車装置ユニット１は、第１および第２の端板２、３の間に、シルクハット型の波動歯車装置５が組み込まれ、当該波動歯車装置の剛性内歯歯車５１と可撓性外歯歯車５２が、クロスローラベアリング４を介して相対回転自在の状態で連結されている。クロスローラベアリングの外輪４１は、軽合金製の外輪本体部材４１１と、この内側に結合した鉄系素材からなる外輪側軌道面形成部材４１２からなる複合部品である。内輪４２も、軽合金製の内輪本体部材４２１と、この外側に結合した鉄系素材からなる内輪側軌道面形成部材４２２を備えた複合部品である。この構成により、極めて軽量な波動歯車装置ユニットを実現できる。



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【特許請求の範囲】

【請求項１】　外輪および内輪に、他部材に対する締結用の固定穴あるいはタップが形成されているクロスローラベアリングにおいて、

前記外輪は、前記固定穴あるいはタップが形成された外輪本体部材と、この外輪本体部材の内周面に固定されていると共に内周面に軌道面が形成されている外輪側軌道面形成部材とを備え、

前記内輪は、前記固定穴あるいはタップが形成された内輪本体部材と、この内輪本体部材の外周面に固定されていると共に外周面に軌道面が形成されている内輪側軌道面形成部材とを備え、

前記外輪側軌道面形成部材および内輪側軌道面形成部材の間に区画形成される軌道内に複数個のコロが挿入されており、

前記外輪側軌道面形成部材および内輪側軌道面形成部材は鉄系素材から形成されており、前記外輪本体部材および内輪本体部材は、前記鉄系素材よりも軽い軽量素材から形成されていることを特徴とするクロスローラベアリング。

【請求項２】　請求項１において、

前記軽量素材は、アルミニウム合金、チタン合金等の軽金属の合金、プラスチック、またはセラミックであることを特徴とするクロスローラベアリング。

【請求項３】　請求項１において、

前記外輪本体部材はアルミニウム合金から形成されており、

鉄系素材からなる前記外輪側軌道面形成部材をアルミニウム合金で鋳込むことにより、または、前記外輪本体部材に対して外輪側軌道面形成部材を焼きばめ等による圧入により、当該外輪側軌道面形成部材と前記外輪本体部材が一体化されていることを特徴とするクロスローラベアリング。

【請求項４】　請求項１において、

前記外輪本体部材はチタン合金から形成されており、

鉄系素材からなる前記外輪側軌道面形成部材に対して、前記外輪本体部材が鍛造により一体化されていることを特徴とするクロスローラベアリング。

【請求項５】　請求項１において、

前記内輪本体部材はチタン合金から形成されており、

鉄系素材からなる前記内輪側軌道面形成部材をチタン合金で鋳込むことにより、または、前記内輪本体部材に対して内輪側軌道面形成部材を焼きばめ等による圧入により、当該内輪側軌道面形成部材と前記内輪本体部材が一体化されていることを特徴とするクロスローラベアリング。

【請求項６】　請求項１において、

前記内輪本体部材はアルミニウム合金から形成されており、

鉄系素材からなる前記内輪側軌道面形成部材に対して、

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前記内輪本体部材が鍛造により一体化されていることを特徴とするクロスローラベアリング。

【請求項７】　請求項１において、

前記外輪本体部材の環状端面には鉄系素材からなるボルト座面用の環状板が取り付けられていることを特徴とするクロスローラベアリング。

【請求項８】　請求項７において、

前記ボルト座面用の環状板には、前記外輪および内輪の間を封鎖するオイルシールが取り付けられていることを特徴とするクロスローラベアリング。

【請求項９】　剛性内歯歯車と、この内側に配置された可撓性外歯歯車と、この内側に配置された波動発生器と、前記剛性内歯歯車および前記可撓性外歯歯車を相対回転自在の状態で連結しているクロスローラベアリングとを有する波動歯車装置ユニットにおいて、

前記クロスローラベアリングは、外輪本体部材と、この外輪本体部材の内周面に固定されていると共に内周面に軌道面が形成されている外輪側軌道面形成部材と、内輪本体部材と、この内輪本体部材の外周面に固定されていると共に外周面に軌道面が形成されている内輪側軌道面形成部材と、前記外輪側軌道面形成部材および内輪側軌道面形成部材の間に区画形成される軌道内に挿入されている複数個のコロとを備えており、

前記外輪側軌道面形成部材および内輪側軌道面形成部材は鉄系素材から形成されており、前記外輪本体部材および内輪本体部材は、前記鉄系素材よりも軽い軽量素材から形成されていることを特徴とする波動歯車装置ユニット。

【請求項１０】　請求項９において、

前記剛性内歯歯車は、歯車本体部材と、この歯車本体部材の内周面に固定されていると共に内周面に内歯が形成されている円環状の歯部形成部材とを備えており、

前記歯部形成部材は鉄系素材から形成されており、前記歯車本体部材は、前記鉄系素材よりも軽い軽量素材から形成されていることを特徴とする波動歯車装置ユニット。

【請求項１１】　請求項９において、

前記波動発生器は、剛性カム板と、この剛性カム板の外周面に嵌めたボールベアリングとを備えており、前記剛性カム板は、鉄系素材よりも軽い軽量素材から形成されていることを特徴とする波動歯車装置ユニット。

【請求項１２】　請求項９ないし１１のうちの何れかの項において、

前記軽量素材は、アルミニウム合金、チタン合金等の軽金属の合金、プラスチック、またはセラミックであることを特徴とする波動歯車装置ユニット。

【請求項１３】　請求項９において、

前記外輪本体部材はアルミニウム合金から形成されており、

鉄系素材からなる前記外輪側軌道面形成部材をアルミニ

ウム合金で鋳込むことにより、または、前記外輪本体部材に対して外輪側軌道面形成部材を焼きばめ等による圧入により、当該外輪側軌道面形成部材と前記外輪本体部材が一体化されていることを特徴とする波動歯車装置ユニット。

【請求項１４】　請求項９において、
前記外輪本体部材はチタン合金から形成されており、
鉄系素材からなる前記外輪側軌道面形成部材に対して、前記外輪本体部材が鍛造により一体化されていることを特徴とする波動歯車装置ユニット。

【請求項１５】　請求項９において、
前記内輪本体部材はチタン合金から形成されており、
鉄系素材からなる前記内輪側軌道面形成部材をチタン合金で鋳込むことにより、または、前記内輪本体部材に対して内輪側軌道面形成部材を焼きばめ等による圧入により、当該内輪側軌道面形成部材と前記内輪本体部材が一体化されていることを特徴とする波動歯車装置ユニット。

【請求項１６】　請求項９において、
前記内輪本体部材はアルミニウム合金から形成されており、
鉄系素材からなる前記内輪側軌道面形成部材に対して、前記内輪本体部材が鍛造により一体化されていることを特徴とする波動歯車装置ユニット。

【請求項１７】　請求項１０において、
前記歯車本体部材はアルミニウム合金から形成されており、
鉄系素材からなる前記歯部形成部材をアルミニウム合金で鋳込むことにより、または、前記歯車本体部材に対して歯部形成部材を焼きばめ等による圧入により、当該歯部形成部材と前記歯車本体部材が一体化されていることを特徴とする波動歯車装置ユニット。

【請求項１８】　請求項１０において、
前記歯車本体部材はチタン合金から形成されており、
鉄系素材からなる前記歯部形成部材に対して、前記歯車本体部材が鍛造により一体化されていることを特徴とする波動歯車装置ユニット。

【請求項１９】　請求項９において、
前記外輪本体部材の環状端面には鉄系素材からなるボルト座面用の環状板が取り付けられていることを特徴とする波動歯車装置ユニット。

【請求項２０】　請求項１９において、
前記ボルト座面用の環状板には、前記外輪および内輪の間を封鎖するオイルシールが取り付けられていることを特徴とする波動歯車装置ユニット。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、クロスローラベアリングに関するものである。また、本発明は、当該クロスローラベアリングによって剛性内歯歯車と可撓性外歯歯車が相対回転自在の状態で連結された構造の波動歯車装置ユニットに関するものである。



【０００２】

【従来の技術】本願人は先に、特開平９－２５０６０８号公報において、クロスローラベアリングを用いた小型でコンパクトな波動歯車装置ユニットを提案している。この公開公報に開示されている波動歯車装置ユニットは、ユニット軸線方向の両側に配置した第１および第２の端板と、これらの端板の間に組み込まれたシルクハット型の波動歯車装置と、波動歯車装置の構成要素であるシルクハット型の可撓性外歯歯車および剛性内歯車を相対回転自在の状態で支持しているクロスローラベアリングとを備え、クロスローラベアリングの外輪と、第１および第２の端板とによって装置ハウジングが構成された構造となっている。

【０００３】また、本願人は、特開平９－３０３４９６号公報においても、カップ型の波動歯車装置を備えた同様な構造の波動歯車装置ユニットを提案している。

【０００４】

【発明が解決しようとする課題】このような波動歯車装置ユニットは小型でコンパクトな構造であるので、ロボットアーム等のような設置場所に制限のある場所に組み込まれるアクチュエータの減速歯車機構として用いるのに適している。

【０００５】ここで、このような部分に使用する構成要素は一般に軽量であることも必要とされる。波動歯車装置ユニットにおいては、特にクロスローラベアリングおよび剛性内歯歯車の重量が大きい。従って、これらの部品を軽量化できれば波動歯車装置ユニットを軽量化できる。

【０００６】しかしながら、クロスローラベアリングにおける軌道面の部分、剛性内歯歯車の歯部は、耐久性、耐摩耗性が要求される部分であるので、重量のある鉄系素材を使用せざるを得ない。このために、クロスローラベアリングの軽量化、波動歯車装置ユニットの軽量化を実現することは困難である。

【０００７】本発明の課題は、この点に鑑みて、ベアリングの軌道面、剛性内歯歯車の歯部の性能を阻害することなく、クロスローラベアリングの軽量化を達成することにある。

【０００８】本発明の課題は、軽量化されたクロスローラベアリングを備えていると共に、剛性内歯歯車の歯部の性能を阻害することなく、波動歯車装置ユニットの軽量化を達成することにある。

【０００９】

【課題を解決するための手段】上記の課題を解決するために、本発明は、外輪および内輪に、他部材に対する締結用の固定穴あるいはタップが形成されているクロスローラベアリングにおいて：前記外輪は、前記固定穴あるいはタップが形成された外輪本体部材と、この外輪本体

部材の内周面に固定されていると共に内周面に軌道面が形成されている外輪側軌道面形成部材とを備え；前記内輪は、前記固定穴あるいはタップが形成された内輪本体部材と、この内輪本体部材の外周面に固定されていると共に外周面に軌道面が形成されている内輪側軌道面形成部材とを備え；前記外輪側軌道面形成部材および内輪側軌道面形成部材の間に区画形成される軌道内に複数個のコロが挿入されており；前記外輪側軌道面形成部材および内輪側軌道面形成部材は鉄系素材から形成されており、前記外輪本体部材および内輪本体部材は、前記鉄系素材よりも軽い軽量素材から形成されていることを特徴としている。

【００１０】前記軽量素材は、アルミニウム合金、チタン合金等の軽金属の合金、プラスチック、またはセラミックとすることができる。

【００１１】ここで、前記外輪本体部材がアルミニウム合金から形成されている場合には、鉄系素材からなる前記外輪側軌道面形成部材をアルミニウム合金で鋳込むことにより、または、前記外輪本体部材に対して外輪側軌道面形成部材を焼きばめ等による圧入により、当該外輪側軌道面形成部材と前記外輪本体部材を一体化することができる。

【００１２】前記外輪本体部材がチタン合金から形成されている場合には、鉄系素材からなる前記外輪側軌道面形成部材に対して、前記外輪本体部材が鍛造により一体化することができる。

【００１３】前記内輪本体部材がチタン合金から形成されている場合には、鉄系素材からなる前記内輪側軌道面形成部材をチタン合金で鋳込むことにより、または、前記内輪本体部材に対して内輪側軌道面形成部材を焼きばめ等による圧入により、当該内輪側軌道面形成部材と前記内輪本体部材を一体化することができる。

【００１４】前記内輪本体部材がアルミニウム合金から形成されている場合には、鉄系素材からなる前記内輪側軌道面形成部材に対して、前記内輪本体部材が鍛造により一体化することができる。

【００１５】ここにおいて、前記外輪本体部材の環状端面には鉄系素材からなるボルト座面用の環状板が取り付けられていることが望ましい。この場合、前記ボルト座面用の環状板には、前記外輪および内輪の間を封鎖するオイルシールが取り付けられていることが望ましい。

【００１６】一方、本発明は、剛性内歯歯車と、この内側に配置された可撓性外歯歯車と、この内側に配置された波動発生器と、前記剛性内歯歯車および前記可撓性外歯歯車を相対回転自在の状態で連結しているクロスローラベアリングとを有する波動歯車装置ユニットにおいて：前記クロスローラベアリングは、外輪本体部材と、この外輪本体部材の内周面に固定されていると共に内周面に軌道面が形成されている外輪側軌道面形成部材と、内輪本体部材と、この内輪本体部材の外周面に固定されていると共に外周面に軌道面が形成されている内輪側軌道面形成部材と、前記外輪側軌道面形成部材および内輪側軌道面形成部材の間に区画形成される軌道内に挿入されている複数個のコロとを備えており；前記外輪側軌道面形成部材および内輪側軌道面形成部材は鉄系素材から形成されており、前記外輪本体部材および内輪本体部材は、前記鉄系素材よりも軽い軽量素材から形成されていることを特徴としている。

【００１７】この構成に加えて、本発明では：前記剛性内歯歯車は、歯車本体部材と、この歯車本体部材の内周面に固定されていると共に内周面に内歯が形成されている円環状の歯部形成部材とを備えており；前記歯部形成部材は鉄系素材から形成されており、前記歯車本体部材は、前記鉄系素材よりも軽い軽量素材から形成されていることを特徴としている。

【００１８】さらに、本発明では：前記波動発生器は、剛性カム板と、この剛性カム板の外周面に嵌めたボールベアリングとを備えており、前記剛性カム板は、鉄系素材よりも軽い軽量素材から形成されていることを特徴としている。

【００１９】ここで、前記軽量素材としては、アルミニウム合金、チタン合金等の軽金属の合金、プラスチック、またはセラミックを採用することができる。

【００２０】また、外輪本体部材と外輪側軌道面形成部材との結合は次のように行うことができる。

【００２１】前記外輪本体部材が鉄系素材よりも線膨張係数の大きなアルミニウム合金から形成されている場合には、鉄系素材からなる前記外輪側軌道面形成部材をアルミニウム合金で鋳込むことにより、または、前記外輪本体部材に対して外輪側軌道面形成部材を焼きばめ等による圧入により、当該外輪側軌道面形成部材と前記外輪本体部材を一体化すればよい。

【００２２】これに対して、前記外輪本体部材が鉄系素材よりも線膨張係数が小さなチタン合金から形成されている場合には、鉄系素材からなる前記外輪側軌道面形成部材に対して、前記外輪本体部材を鍛造により一体化すればよい。

【００２３】一方、内輪本体部材と、軌道面を形成している内輪側軌道面形成部材との結合は次のように行うことができる。

【００２４】前記内輪本体部材がチタン合金から形成されている場合には、鉄系素材からなる前記内輪側軌道面形成部材をチタン合金で鋳込むことにより、または、前記内輪本体部材に対して内輪側軌道面形成部材を焼きばめ等による圧入により、当該内輪側軌道面形成部材と前記内輪本体部材を一体化することができる。

【００２５】これに対して、前記内輪本体部材がアルミニウム合金から形成されている場合には、鉄系素材からなる前記内輪側軌道面形成部材に対して、前記内輪本体部材を鍛造により一体化することができる。

【００２６】剛性内歯歯車を構成している歯車本体部材と歯部形成部材との結合は、外輪の場合と同様に次のように行うことができる。

【００２７】前記歯車本体部材がアルミニウム合金から形成されている場合には、鉄系素材からなる前記歯部形成部材をアルミニウム合金で鋳込むことにより、または、前記歯車本体部材に対して歯部形成部材を焼きばめ等による圧入により、当該歯部形成部材と前記歯車本体部材を一体化することができる。

【００２８】これに対して、前記歯車本体部材がチタン合金から形成されている場合には、鉄系素材からなる前記歯部形成部材に対して、前記歯車本体部材を鍛造により一体化することができる。

【００２９】ここで、前記外輪本体部材の環状端面には鉄系素材からなるボルト座面用の環状板を取り付ければ、当該部分を締結ボルトを用いて締結する場合に必要とされる十分な強度のボルト座面を形成することができる。

【００３０】また、前記ボルト座面用の環状板には、前記外輪および内輪の間を封鎖するオイルシールを取り付けることもできる。

【００３１】

【発明の実施の形態】以下に、図面を参照して、本発明を適用した波動歯車装置ユニットについて説明する。

【００３２】［第１の実施例］

（全体構成）図１には、シルクハット型波動歯車装置を備えた波動歯車装置ユニットの断面構成を示してある。本例の波動歯車装置ユニット１は、ユニット軸線１ａの方向に一定の間隔を開けて配置した第１の端板２および第２の端板３と、これらの第１および第２の端板２、３の間に配置されたクロスローラベアリング４とを有している。これら第１、第の端板２、３およびクロスローラベアリング４の外輪４１によって構成されるユニットハウジングの内部に、シルクハット型の波動歯車装置５が組み込まれている。また、第１および第２の端板２、３の中心には軸孔が形成されており、ここには、ボールベアリング６、７によって回転自在に支持された中空入力軸８が貫通している。

【００３３】クロスローラベアリング４は、外輪４１と内輪４２と、これら内外輪の間に区画形成されている円環状軌道に挿入された複数のコロ４３とを備えている。外輪４１は、円環状の外輪本体部材４１１と、この外輪本体部材の内周面に一体化されていると共に内周面に軌道面が形成されている円環状の外輪側軌道面形成部材４１２とを備えた複合部品である。

【００３４】内輪４２は、円環状をした広幅の内輪本体部材４２１と、この内輪本体部材４２１の一方の端部側の外周面部分に一体化されていると共に外周面に軌道面が形成されている円環状の内輪側軌道面形成部材４２２とを備えた複合部品である。さらに、本例の内輪４２は、その内輪本体部材４２１の他方の端部側の内周面部分に一体化されていると共に内周面に内歯５１１が形成されている円環状の歯部形成部材５１２を備えている。すなわち、本例の内輪４２は以下に述べるシルクハット型の波動歯車装置５の剛性内歯歯車との兼用部品である。この構成の内輪４２の内輪本体部材４２１は、不図示の締結用ボルトによって、第２の端板３に締結固定されている。

【００３５】シルクハット型の波動歯車装置５は、円環状の剛性内歯歯車５１と、シルクハット型の可撓性外歯歯車５２と、楕円形輪郭の波動発生器５３とを備えている。剛性内歯歯車５１は上記のようにクロスローラベアリング４の内輪４２と一体物として形成されており、内歯５１１が内周面に形成されている円環状の歯部形成部材５１２のみが別部材から形成され、内歯歯車兼用の内輪４２の内周面に一体化されている。

【００３６】可撓性外歯歯車５２は円筒状の胴部５２１と、この一端に連続して半径方向の外方に広がっている環状のダイヤフラム５２２と、このダイヤフラム５２２の外周縁に連続している厚肉の環状ボス５２３と、胴部５２１の他端部分の外周面に形成されている外歯５２４とを備え、全体としてシルクハット形状をしたものである。環状ボス５２３は、クロスローラベアリング４の外輪４１の環状端面と第１の端板２の間に挟まれ、締結ボルト（図示せず）によって、これらの部品に締結固定されている。よって、可撓性外歯歯車５２と剛性内歯歯車５１はクロスローラベアリング４を介して相対回転自在の状態となっている。

【００３７】波動発生器５３は、入力軸８の外周面に形成されている楕円形輪郭の剛性カム板部分５３１とボールベアリング５３２とを備え、このボールベアリング５３２は、剛性カム板部分５３１の外周面とと可撓性外歯車５２の外歯５２４が形成されている部分の内周面との間に嵌め込まれている。

【００３８】ここで、外輪４１の外輪本体部材４１１に形成したボルト孔４１４が開口している外輪本体部材の環状端面４１５には、ボルト座面形成用の環状板９が取り付けられ、この環状板９も締結用ボルトによって外輪本体部材４１１の側に締結固定されている。この環状板９の内周縁側の部分には、オイルシール用のシールリング９１が取り付けられており、このシールリング９１によって外輪４１と内輪４２の隙間がシールされている。

【００３９】この構成のシルクハット型の波動歯車装置ユニット１では、入力回転軸８の第１の端板３から突出している突出部分が、モーター出力軸等の回転源に接続固定される。また、第１の端板２あるいは第２の端板３が、負荷側に接続固定される。入力回転軸８が高速回転すると、楕円形状の波動発生器４３によって楕円形状に撓められて円周方向の２か所で内歯４２４に噛み合っている外歯４１４の噛み合い部分は円周方向に移動する。

外歯と内歯の歯数は異なっているので、歯数差に応じた相対回転がこれらの外歯と内歯の間に発生する。この回転は、入力回転数に比べて大幅に減速されたものとなる。第2の端板2および第2の端板3のうちの一方が負荷側に接続され、他方が回転しないように固定されるので、負荷側に接続された端板の側から減速回転が出力されて負荷側に伝達される。

【００４０】（各部品の素材について）上述のように、本例では、クロスローラベアリング4の外輪41は、外輪本体部材411と外輪側軌道面形成部材412からなる複合部品である。同様に、内輪42は、内輪本体部材421と、内輪側軌道面形成部材422と、内周面に内歯511が形成されている歯部形成部材512からなる複合部品である。

【００４１】外輪本体部材411および内輪本体部材421は、鉄系素材よりも軽い軽量素材から形成されており、例えば、アルミニウム合金、チタン合金等の軽金属の合金、プラスチック、またはセラミックを採用することができる。これに対して、軌道面が形成されている外輪側軌道面形成部材412、内輪側軌道面形成部材422および、内歯が形成されている歯部形成部材512は一般的に使用されている鉄系素材から形成されている。

【００４２】さらに、本例では、入力軸8もアルミニウム合金、チタン合金等の軽金属の合金、プラスチック、またはセラミック等の軽量素材から形成されており、その外周面に形成されている波動発生器53の剛性カム板部分531も同一の軽量素材から形成されている。

【００４３】（複合部品の製造方法）次に、複合部品である外輪41および内輪42の製造方法について説明する。まず、外輪本体部材411と外輪側軌道面形成部材412との結合は次のようにして行うことができる。

【００４４】外輪本体部材411が鉄系素材よりも線膨張係数の大きなアルミニウム合金から形成されている場合には、鉄系素材からなる外輪側軌道面形成部材412をアルミニウム合金で鋳込むことにより、これらの部品を一体化できる。この代わりに、外輪本体部材411に対して外輪側軌道面形成部材412を焼きばめ等による圧入することにより、これらの部品を一体化できる。鋳込みの場合には、双方の部材を一体化した後に、外輪側軌道面形成部材412の内周面（軌道面）に、高周波焼き入れ、またはレーザー焼き入れをし、しかる後に機械加工を施せばよい。

【００４５】これに対して、外輪本体部材411が鉄系素材よりも線膨張係数が小さなチタン合金から形成されている場合には、鉄系素材からなる外輪側軌道面形成部材412に対して、外輪本体部材411を鍛造により一体化すればよい。鍛造の際における双方の部材の接合部に接着剤を塗布してもよい。また、外輪側軌道面形成部材412の内周面（軌道面）は予め熱処理により硬化させておいてもよいし、双方の部材の接合後に、高周波焼き入れ、またはレーザー焼き入れを施して硬化させてもよい。

【００４６】なお、外輪本体部材411と外輪側軌道面形成部材412の線膨張係数の差が$5\times10^{-6}$以内の場合には、双方の部材は、鋳込み、鍛造、圧入、エポキシ樹脂等の接着剤による接合等により一体化することができる。

【００４７】次に、内輪42を構成している三部品の結合方法について説明する。まず、内輪本体部材421がチタン合金から形成されている場合には、鉄系素材からなる内輪側軌道面形成部材422をチタン合金で鋳込むことにより、または、内輪本体部材421に対して内輪側軌道面形成部材422を焼きばめ等により圧入することにより、当該内輪側軌道面形成部材421と内輪本体部材422を一体化することができる。この場合、内輪側軌道面形成部材422の外周面（軌道面）は、高周波焼き入れ、レーザー焼き入れにより硬化させ、しかる後に機械加工を施せば良い。

【００４８】これに対して、内輪本体部材421がアルミニウム合金から形成されている場合には、鉄系素材からなる内輪側軌道面形成部材422に対して、内輪本体部材421を鍛造により一体化すればよい。また、焼きばめ等による圧入によって一体化することもできる。鍛造、圧入の際、双方の部材の接合部に接着剤を使用することもできる。また、内輪側軌道面形成部材422の外周面（軌道面）には予め熱処理により硬化させておいてもよいし、接合後に、高周波焼き入れ、レーザー焼き入れを施して硬化させてもよい。

【００４９】なお、内輪本体部材411と内輪側軌道面形成部材412の線膨張係数の差が$5\times10^{-6}$以内の場合には、双方の部材は、鋳込み、鍛造、圧入、エポキシ樹脂等の接着剤による接合等により一体化することができる。

【００５０】次に、内輪本体部材411と剛性内歯歯車51の歯部形成部材512との結合も、上記の外輪における場合と同様に行うことができる。

【００５１】ここで、複合部品である外輪41、内輪42の構成部品の結合強度を高めるためには、結合される各部品に対して、軸線方向、円周方向、あるいは双方の方向に対する抜け止め用の凹凸を設けておくことが望ましい。また、軌道面が形成されている外輪側軌道面形成部材412および内輪側円環状部材422における軌道面が形成されている部分の厚さは、コロ43の直径の1／5以上の寸法とすることが望ましい。

【００５２】（ボルト座面用の環状部材について）本例では、外輪本体部材411が締結用ボルトによって第1の端板2の側に締結固定される。締結用ボルトのボルトの座面が、軽量素材からなる外輪本体部材411の環状端面415とされると、ボルトの座面圧が高い場合には軽合金の強度では不足する場合がある。そこで、本例で

は上記にように、鉄系素材からなる環状板9を予めボルト座面となる外輪本体部材411の環状端面415に配置し、当該環状板9の表面がボルト座面となるようにしている。

【0053】また、本例では、ボルト座面を形成するために配置する環状板9の内周縁にオイルシール91を取り付けた構成としてある。この結果、環状板9を取り付けることにより同時にオイルシールも形成されるので、オイルシールを取り付けるための作業が不要となり、また、オイルシールを取り付けるための機構も不要となる。

【0054】[第2の実施例]次に、図2は本発明を適用したカップ型波動歯車装置を備えた波動歯車装置ユニットの断面図である。この波動歯車装置ユニット100は波動歯車装置110を有し、この波動歯車装置110は、内歯123が内周面に形成されている環状の剛性内歯歯車120と、この内側に配置されたカップ型の可撓性外歯歯車130と、この内側にはめ込まれている波動発生器140とを備えている。また、波動歯車装置ユニット100は、剛性内歯歯車110と可撓性外歯歯車120を相対回転自在の状態で連結しているクロスローラベアリング150を有している。

【0055】剛性内歯歯車120は、円筒状の歯車本体部材121と、この歯車本体部材121の一端側の内周面に一体化されている円環状の歯部形成部材122とからなる複合部品であり、この歯部形成部材122の内周面には内歯123が形成されている。

【0056】カップ状の可撓性外歯歯車130は、円筒状の胴部131と、その一方の開口端の外周面に形成した外歯132と、胴部131の他方の開口端に連続している環状のダイヤフラム133と、このダイヤフラム133に連続している厚肉の環状ボス134とを備えている。

【0057】波動発生器140は、例えば楕円形の輪郭を備えた剛性カム板141と、その外周に嵌めたボールベアリング142と、剛性カム板141の中心にはモータ出力軸(図示せず)等が連結される軸孔143が形成されている。

【0058】クロスローラベアリング150は、外輪151と、内輪155と、これらの間に形成された環状の軌道に挿入した複数のコロ160とを有している。外輪151は、円環状の外輪本体部材152と、この内側に結合された円環状の外輪側軌道面形成部材153とからなる複合部品であり、外輪側軌道面形成部材153の内周面にV状の軌道面が形成されている。この構成の外輪151は締結用ボルト154によって剛性内歯歯車120の環状端面に締結固定されている。

【0059】内輪155は、厚肉の円板状の内輪本体部材156と、この外周面に結合した円環状の内輪側軌道面形成部材157とからなる複合部品であり、この内輪側軌道面形成部材157の外周面にV状の軌道面が形成されている。この構成の内輪155は、締結ボルト158によって、可撓性外歯歯車130のボス134に締結固定されており、また、当該内輪の内輪本体部材156の外側端面に被駆動側部材(図示せず)が連結されるようになっている。

【0060】また、本例においても、外輪本体部材152の環状端面にはボルト座面を形成するための環状板170が配置されている。さらに、当該環状板170の内周縁にはオイルシール171が取り付けられており、このオイルシール171によって、外輪と内輪の間がシール状態とされている。

【0061】本例の波動歯車装置ユニット100においても、複合部品である外輪151、内輪155、および剛性内歯歯車120は、前述の実施例と同様な素材からなる部品によって構成されている。すなわち、耐久性、耐摩耗性等が必要とされる外輪側軌道面形成部材153、内輪側軌道面形成部材157、剛性内歯歯車の歯部形成部材122は鉄系素材から形成された部品である。これに対して、外輪本体部材152、内輪本体部材156、歯車本体部材121は軽合金等の軽量素材から形成された部品である。これらの各部品の結合方法は上記の第1の実施例と同様な方法を採用することができる。また、波動発生器140の剛性カム板141の部分も軽量素材から形成することができる。

【0062】[その他の実施の形態]なお、上記の例は波動歯車装置ユニットに関するものであるが、本発明は、クロスローラベアリング単体に対しても同様に適用できる。すなわち、上記の各例におけるクロスローラベアリングにおいて、歯部形成部材が無いものを、波動歯車装置ユニット以外のユニット、例えば、遊星歯車減速機ユニット等における軸受けとして用いれば、ユニット全体の軽量化を実現できる。

【0063】

【発明の効果】以上説明したように、本発明のクロスローラベアリングでは、その外輪本体部分および内輪本体部分を軽量素材から形成し、強度が必要とされる外輪側軌道面および内輪側軌道面の部分のみを鉄系素材から形成し、これらの部材を結合して一体化した構成を採用している。従って、本発明によれば、非常に軽量なクロスローラベアリングを実現できる。

【0064】一方、本発明の波動歯車装置ユニットでは、その重量の過半部分を占有しているクロスローラベアリングの外輪本体部分および内輪本体部分を軽量素材から形成し、強度が必要とされる外輪側軌道面および内輪側軌道面の部分のみを鉄系素材から形成し、これらの部材を結合して一体化した構成を採用している。従って、本発明によれば、小型でコンパクトであると共に、非常に軽量な波動歯車装置ユニットを実現できる。

【0065】また、本発明では、上記の構成に加えて、

１３

波動歯車装置の重量の過半部分を占めている剛性内歯歯車の歯車本体部分を軽量素材により形成し、強度が必要とされる内歯部分のみを鉄系の素材から形成し、これらの部材を結合して一体化した構成を採用している。従って、極めて軽量な波動歯車装置ユニットを実現することができる。

【図面の簡単な説明】

【図１】本発明を適用したシルクハット型の波動歯車装置ユニットの概略断面図である。

【図２】本発明を適用したカップ型の波動歯車装置ユニットの概略断面図である。

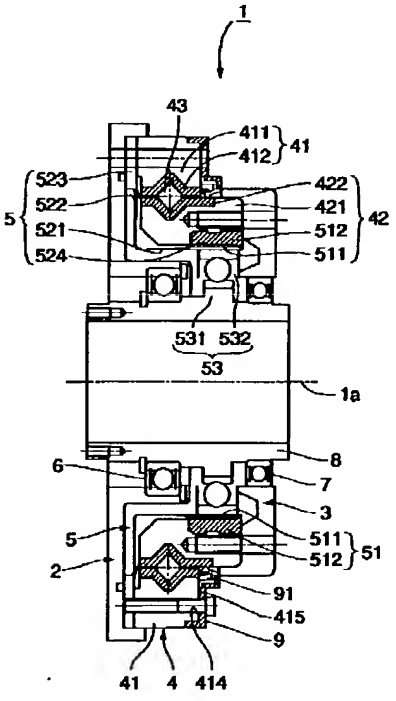
【符号の説明】

１、１００　波動歯車装置ユニット
２、３　端板
４、１５０　クロスローラベアリング

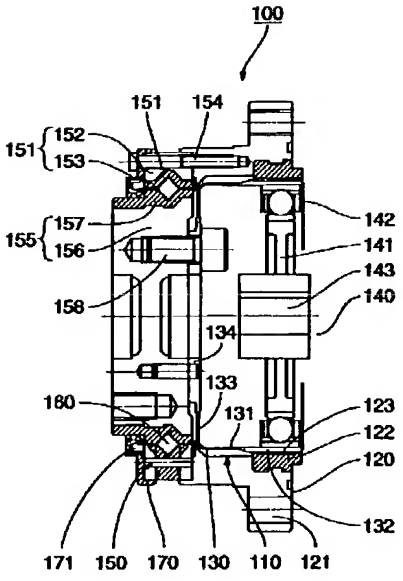
１４

４１、１５１　外輪
４１１、１５２　外輪本体部材
４１２、１５３　外輪側軌道面形成部材
４２、１５５　内輪
４２１、１５６　内輪本体部材
４２２、１５７　内輪側軌道面形成部材
４３、１６０　コロ
５、１１０　波動歯車装置
５１、１２０　剛性内歯歯車
５１１、１２３　内歯
５１２、１２２　歯部形成部材
５２、１３０　可撓性外歯歯車
８　入力軸
９、１７０　環状板
９１、１７１　オイルシール

【図１】




【図２】




フロントページの続き

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DA09 DA16 DA20 EA01 EA02
EA14 EA31 EA41 FA51 FA53
FA55 GA60

* NOTICES *



## DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to cloth roller bearing. Moreover, this invention relates to the wave-motion gearing unit of the structure where the rigid internal gear and the flexible external-tooth gearing were connected by the cloth roller bearing concerned in the condition in which relative rotation is free.
[0002]
[Description of the Prior Art] this application people have proposed the small and compact wave-motion gearing unit using cloth roller bearing in JP,9-250608,A previously. The wave-motion gearing unit currently indicated by this open official report The wave-motion gearing of the silk hat mold incorporated between the 1st and 2nd end plates arranged on both sides of the direction of a unit axis, and these end plates, It has the cloth roller bearing currently supported in the condition in which relative rotation of the flexible external-tooth gearing and the rigid internal gear of a silk hat mold which are the component of wave-motion gearing is free. The outer ring of spiral wound gasket of cloth roller bearing, It has the structure where equipment housing was constituted by the 1st and 2nd end plates.
[0003] Moreover, this application people have proposed the wave-motion gearing unit of the same structure equipped with the wave-motion gearing of a cup mold also in JP,9-303496,A.
[0004]
[Problem(s) to be Solved by the Invention] Since it is structure small [ such a wave-motion gearing unit ] and compact, it is suitable for using as a reduction gear device of the actuator built into the location which has a limit in installations, such as a robot arm.
[0005] Here, it is needed that the component used for such a part is generally also lightweight. Especially in a wave-motion gearing unit, the weight of cloth roller bearing and a rigid internal gear is large. Therefore, if-izing of these components can be carried out [ lightweight ],-izing of the wave-motion gearing unit can be carried out [ lightweight ].
[0006] However, since the part of the orbital plane in cloth roller bearing and the tooth part of a rigid internal gear are parts as which endurance and abrasion resistance are required, an iron system material with weight must be used for them. For this reason, it is difficult to realize lightweight-ization of lightweight-izing of cloth roller bearing, and a wave-motion gearing unit.
[0007] The technical problem of this invention is to attain lightweight-ization of cloth roller bearing, without checking the engine performance of the tooth part of a raceway side and a rigid internal gear in view of this point.
[0008] The technical problem of this invention is to attain lightweight-ization of a wave-motion gearing unit, without checking the engine performance of the tooth part of a rigid internal gear, while having the lightweight-ized cloth roller bearing.
[0009]
[Means for Solving the Problem] In the cloth roller bearing in which the fixed hole or tap for conclusion is formed in order to solve the above-mentioned technical problem the :aforementioned outer ring of

spiral wound gasket [ as opposed to / in this invention / other members to an outer ring of spiral wound gasket and an inner ring of spiral wound gasket ] It has the body member of an outer ring of spiral wound gasket in which said fixed hole or tap was formed, and the outer-ring-of-spiral-wound-gasket side orbital plane formation member by which the orbital plane is formed in inner skin while being fixed to the inner skin of this body member of an outer ring of spiral wound gasket. The; aforementioned inner ring of spiral wound gasket The inner-ring-of-spiral-wound-gasket body member in which said fixed hole or tap was formed, It has the inner-ring-of-spiral-wound-gasket side orbital plane formation member by which the orbital plane is formed in the peripheral face while being fixed to the peripheral face of this inner-ring-of-spiral-wound-gasket body member. Between the; aforementioned outer-ring-of-spiral-wound-gasket side orbital plane formation member and an inner-ring-of-spiral-wound-gasket side orbital plane formation member It is characterized by inserting two or more koro into the orbit by which partition formation is carried out, forming the; aforementioned outer-ring-of-spiral-wound-gasket side orbital plane formation member and the inner-ring-of-spiral-wound-gasket side orbital plane formation member from the iron system material, and forming said body member of an outer ring of spiral wound gasket, and the inner-ring-of-spiral-wound-gasket body member from the light-weight material lighter than said iron system material.

[0010] Said light-weight material can be made into the alloy of light metals, such as an aluminium alloy and a titanium alloy, plastics, or a ceramic.

[0011] Here, when said body member of an outer ring of spiral wound gasket is formed from the aluminium alloy, the outer-ring-of-spiral-wound-gasket side orbital plane formation member concerned and said body member of an outer ring of spiral wound gasket can be unified by casting said outer-ring-of-spiral-wound-gasket side orbital plane formation member which consists of an iron system material with an aluminium alloy, or press fit according an outer-ring-of-spiral-wound-gasket side orbital plane formation member to a shrink fitting etc. to said body member of an outer ring of spiral wound gasket.

[0012] When said body member of an outer ring of spiral wound gasket is formed from the titanium alloy, said body member of an outer ring of spiral wound gasket can unify with forging to said outer-ring-of-spiral-wound-gasket side orbital plane formation member which consists of an iron system material.

[0013] When said inner-ring-of-spiral-wound-gasket body member is formed from the titanium alloy, the inner-ring-of-spiral-wound-gasket side orbital plane formation member concerned and said inner-ring-of-spiral-wound-gasket body member can be unified by casting said inner-ring-of-spiral-wound-gasket side orbital plane formation member which consists of an iron system material with a titanium alloy, or press fit according an inner-ring-of-spiral-wound-gasket side orbital plane formation member to a shrink fitting etc. to said inner-ring-of-spiral-wound-gasket body member.

[0014] When said inner-ring-of-spiral-wound-gasket body member is formed from the aluminium alloy, said inner-ring-of-spiral-wound-gasket body member can unify with forging to said inner-ring-of-spiral-wound-gasket side orbital plane formation member which consists of an iron system material.

[0015] In here, it is desirable to attach in the annular end face of said body member of an outer ring of spiral wound gasket the annular plate for bolt bearing surfaces which consists of an iron system material. In this case, it is desirable to attach in the annular plate for said bolt bearing surfaces the oil seal which blocks between said outer ring of spiral wound gasket and inner rings of spiral wound gasket.

[0016] With the flexible external-tooth gearing with which this invention has been arranged on the other hand at a rigid internal gear and this inside In the wave-motion gearing unit which has the wave-motion generator arranged at this inside, and the cloth roller bearing which has connected said rigid internal gear and said flexible external-tooth gearing in the condition in which relative rotation is free the :aforementioned cloth roller bearing The body member of an outer ring of spiral wound gasket, and the outer-ring-of-spiral-wound-gasket side orbital plane formation member by which the orbital plane is formed in inner skin while being fixed to the inner skin of this body member of an outer ring of spiral wound gasket, An inner-ring-of-spiral-wound-gasket body member and the inner-ring-of-spiral-wound-gasket side orbital plane formation member by which the orbital plane is formed in the peripheral face while being fixed to the peripheral face of this inner-ring-of-spiral-wound-gasket body member, Have

two or more koro inserted into the orbit by which partition formation is carried out between said outer-ring-of-spiral-wound-gasket side orbital plane formation member and an inner-ring-of-spiral-wound-gasket side orbital plane formation member, and the; aforementioned outer-ring-of-spiral-wound-gasket side orbital plane formation member and the inner-ring-of-spiral-wound-gasket side orbital plane formation member are formed from the iron system material. Said body member of an outer ring of spiral wound gasket and the inner-ring-of-spiral-wound-gasket body member are characterized by being formed from the light-weight material lighter than said iron system material.

[0017] this configuration -- in addition -- this invention -- : -- the tooth part formation member of the shape of a circular ring by which the internal tooth is formed in inner skin while said rigid internal gear is being fixed to the inner skin of a gearing body member and this gearing body member -- having -- **** --; -- it is characterized by forming said tooth part formation member from the iron system material, and forming said gearing body member from the light-weight material lighter than said iron system material.

[0018] Furthermore, in this invention, the :aforementioned wave-motion generator is equipped with the rigid cam plate and the ball bearing put on the peripheral face of this rigid cam plate, and is characterized by forming said rigid cam plate from the light-weight material lighter than an iron system material.

[0019] Here, as said light-weight material, the alloy of light metals, such as an aluminium alloy and a titanium alloy, plastics, or a ceramic is employable.

[0020] Moreover, association with the body member of an outer ring of spiral wound gasket and an outer-ring-of-spiral-wound-gasket side orbital plane formation member can be performed as follows.

[0021] What is necessary is just to unify the outer-ring-of-spiral-wound-gasket side orbital plane formation member concerned and said body member of an outer ring of spiral wound gasket by casting said outer-ring-of-spiral-wound-gasket side orbital plane formation member which consists of an iron system material with an aluminium alloy, or press fit according an outer-ring-of-spiral-wound-gasket side orbital plane formation member to a shrink fitting etc. to said body member of an outer ring of spiral wound gasket, when said body member of an outer ring of spiral wound gasket is formed from the aluminium alloy with a bigger coefficient of linear expansion than an iron system material.

[0022] On the other hand, what is necessary is just to unify said body member of an outer ring of spiral wound gasket with forging to said outer-ring-of-spiral-wound-gasket side orbital plane formation member which consists of an iron system material, when said body member of an outer ring of spiral wound gasket is formed from the titanium alloy with a coefficient of linear expansion smaller than an iron system material.

[0023] On the other hand, association with an inner-ring-of-spiral-wound-gasket body member and the inner-ring-of-spiral-wound-gasket side orbital plane formation member which forms the orbital plane can be performed as follows.

[0024] When said inner-ring-of-spiral-wound-gasket body member is formed from the titanium alloy, the inner-ring-of-spiral-wound-gasket side orbital plane formation member concerned and said inner-ring-of-spiral-wound-gasket body member can be unified by casting said inner-ring-of-spiral-wound-gasket side orbital plane formation member which consists of an iron system material with a titanium alloy, or press fit according an inner-ring-of-spiral-wound-gasket side orbital plane formation member to a shrink fitting etc. to said inner-ring-of-spiral-wound-gasket body member.

[0025] On the other hand, when said inner-ring-of-spiral-wound-gasket body member is formed from the aluminium alloy, said inner-ring-of-spiral-wound-gasket body member can be unified with forging to said inner-ring-of-spiral-wound-gasket side orbital plane formation member which consists of an iron system material.

[0026] Association with the gearing body member and tooth part formation member which constitute the rigid internal gear can be performed as follows like the case of an outer ring of spiral wound gasket.

[0027] When said gearing body member is formed from the aluminium alloy, the tooth part formation member concerned and said gearing body member can be unified by casting said tooth part formation member which consists of an iron system material with an aluminium alloy, or press fit according a

tooth part formation member to a shrink fitting etc. to said gearing body member.
[0028] On the other hand, when said gearing body member is formed from the titanium alloy, said gearing body member can be unified with forging to said tooth part formation member which consists of an iron system material.
[0029] Here, if the annular plate for bolt bearing surfaces which consists of an iron system material is attached in the annular end face of said body member of an outer ring of spiral wound gasket, the bolt bearing surface of sufficient reinforcement needed when concluding the part concerned using a conclusion bolt can be formed.
[0030] Moreover, the oil seal which blocks between said outer ring of spiral wound gasket and inner rings of spiral wound gasket can also be attached in the annular plate for said bolt bearing surfaces.
[0031]
[Embodiment of the Invention] The wave-motion gearing unit which applied this invention to below with reference to the drawing is explained.
[0032] [The 1st example]
(Whole configuration) The cross-section configuration of the wave-motion gearing unit equipped with silk hat mold wave-motion gearing is shown in drawing 1 . The wave-motion gearing unit 1 of this example has the cloth roller bearing 4 arranged between the 1st end plate 2 and the 2nd end plate 3 which have opened and arranged fixed spacing in the direction of unit axis 1a, and these 1st and 2nd end plates 2 and 3. The wave-motion gearing 5 of a silk hat mold is included in the interior of unit housing constituted by the end plates 2 and 3 of these 1st **, and the outer ring of spiral wound gasket 41 of the cloth roller bearing 4. Moreover, the boss is formed in the core of the 1st and 2nd end plates 2 and 3, and the hollow input shaft 8 supported by ball bearings 6 and 7 free [ rotation ] has penetrated here.
[0033] The cloth roller bearing 4 is equipped with an outer ring of spiral wound gasket 41, an inner ring of spiral wound gasket 42, and two or more koro 43 inserted in the orbit in a circle by which partition formation is carried out between these inside-and-outside rings. An outer ring of spiral wound gasket 41 is the composite part equipped with the circular ring-like body member 411 of an outer ring of spiral wound gasket, and the outer-ring-of-spiral-wound-gasket side orbital plane formation member 412 of the shape of a circular ring by which the orbital plane is formed in inner skin while uniting with the inner skin of this body member of an outer ring of spiral wound gasket.
[0034] An inner ring of spiral wound gasket 42 is the composite part equipped with the inner-ring-of-spiral-wound-gasket side orbital plane formation member 422 of the shape of a circular ring by which the orbital plane is formed in the peripheral face while uniting with the peripheral face part by the side of one edge of the double-width inner-ring-of-spiral-wound-gasket body member 421 which carried out the shape of a circular ring, and this inner-ring-of-spiral-wound-gasket body member 421. Furthermore, the inner ring of spiral wound gasket 42 of this example is equipped with the tooth part formation member 512 of the shape of a circular ring by which the internal tooth 511 is formed in inner skin while uniting with the inner skin part by the side of the other-end section of the inner-ring-of-spiral-wound-gasket body member 421. That is, the inner rings of spiral wound gasket 42 of this example are combination components with the rigid internal gear of the wave-motion gearing 5 of the silk hat mold described below. Conclusion immobilization of the inner-ring-of-spiral-wound-gasket body member 421 of the inner ring of spiral wound gasket 42 of this configuration is carried out with the non-illustrated bolt for conclusion at the 2nd end plate 3.
[0035] The wave-motion gearing 5 of a silk hat mold is equipped with the rigid circular ring-like internal gear 51, the flexible external-tooth gearing 52 of a silk hat mold, and the wave-motion generator 53 of an ellipse form profile. Only the tooth part formation member 512 of the shape of a circular ring by which it is the inner ring of spiral wound gasket 42 of the cloth roller bearing 4 and really formed as mentioned above as an object, and the internal tooth 511 is formed in inner skin is formed from another member, and the rigid internal gear 51 is united with the inner skin of the inner ring of spiral wound gasket 42 of internal-gear combination.
[0036] The flexible external-tooth gearing 52 has the cylinder-like drum section 521, the annular diaphram 522 which followed this end and has spread in the way outside radial, the heavy-gage annular

boss 523 who is following the periphery edge of this diaphram 522, and the external tooth 524 currently formed in the peripheral face for the other end of a drum section 521, and does a silk hat configuration as a whole. The annular boss 523 is inserted between the annular end face of the outer ring of spiral wound gasket 41 of the cloth roller bearing 4, and the 1st end plate 2, and conclusion immobilization is done with the conclusion bolt (not shown) at these components. Therefore, the flexible external-tooth gearing 52 and the rigid internal gear 51 are in the condition in which relative rotation is free through the cloth roller bearing 4.

[0037] the rigid cam plate part 531 and ball bearing 532 of an ellipse form profile by which the wave-motion generator 53 is formed in the peripheral face of an input shaft 8 -- having -- this ball bearing 532 -- the peripheral face of the rigid cam plate part 531 -- ** -- it is inserted in between the inner skin of the part in which the external tooth 524 of the flexible external gear 52 is formed.

[0038] Here, the annular plate 9 for bolt bearing-surface formation is attached in the annular end face 415 of the body member of an outer ring of spiral wound gasket in which the bolthole 414 formed in the body member 411 of an outer ring of spiral wound gasket of an outer ring of spiral wound gasket 41 is carrying out opening, and conclusion immobilization also of this annular plate 9 is carried out with the bolt for conclusion at the body member 411 side of an outer ring of spiral wound gasket. The seal ring 91 for oil seal is attached in the part of the inner circumference veranda of this annular plate 9, and the seal of the clearance between an outer ring of spiral wound gasket 41 and an inner ring of spiral wound gasket 42 is carried out to it with this seal ring 91.

[0039] In the wave-motion gearing unit 1 of the silk hat mold of this configuration, connection immobilization of the part for the lobe projected from the 1st end plate 3 of the input revolving shaft 8 is carried out in sources of rotation, such as a motor output shaft. Moreover, connection immobilization of the 1st end plate 2 or 2nd end plate 3 is carried out at a load side. If the input revolving shaft 8 carries out high-speed rotation, the engagement part of the external tooth 414 which was stir-fried by elliptical and has geared to the internal tooth 424 by two places of a circumferencial direction by the elliptical wave-motion generator 43 will move to a circumferencial direction. Since the numbers of teeth of an external tooth and an internal tooth differ, the relative rotation according to a number-of-teeth difference occurs among these external teeth and internal teeth. This rotation was sharply slowed down compared with the input rotational frequency. Since it is fixed so that either the 2nd end plate 2 or the 2nd end plate 3 may be connected to a load side and another side may not rotate, moderation rotation is outputted from the end plate side connected to the load side, and it is transmitted to a load side.

[0040] (material of each part article) As mentioned above, the outer ring of spiral wound gasket 41 of the cloth roller bearing 4 is composite part which consists of a body member 411 of an outer ring of spiral wound gasket, and an outer-ring-of-spiral-wound-gasket side orbital plane formation member 412 in this example. Similarly, an inner ring of spiral wound gasket 42 is composite part which consists of the inner-ring-of-spiral-wound-gasket body member 421, an inner-ring-of-spiral-wound-gasket side orbital plane formation member 422, and a tooth part formation member 512 by which the internal tooth 511 is formed in inner skin.

[0041] The body member 411 of an outer ring of spiral wound gasket and the inner-ring-of-spiral-wound-gasket body member 421 are formed from the light-weight material lighter than an iron system material, for example, the alloy of light metals, such as an aluminium alloy and a titanium alloy, plastics, or a ceramic can be used for them. On the other hand, the outer-ring-of-spiral-wound-gasket side orbital plane formation member 412 in which the orbital plane is formed, the inner-ring-of-spiral-wound-gasket side orbital plane formation member 422, and the tooth part formation member 512 in which the internal tooth is formed are formed from the iron system material currently generally used.

[0042] Furthermore, in this example, the input shaft 8 and the rigid cam plate part 531 of the wave-motion generator 53 which is formed from light-weight materials, such as an alloy of light metals, such as an aluminium alloy and a titanium alloy, plastics, or a ceramic, and is formed in the peripheral face are formed from the same light-weight material.

[0043] (The manufacture approach of composite part) Next, the manufacture approach of of the outer ring of spiral wound gasket 41 and inner ring of spiral wound gasket 42 which are composite part is

explained. First, association with the body member 411 of an outer ring of spiral wound gasket and the outer-ring-of-spiral-wound-gasket side orbital plane formation member 412 can be performed as follows.

[0044] When the body member 411 of an outer ring of spiral wound gasket is formed from the aluminium alloy with a bigger coefficient of linear expansion than an iron system material, these components can be unified by casting the outer-ring-of-spiral-wound-gasket side orbital plane formation member 412 which consists of an iron system material with an aluminium alloy. These components can be unified by [ which instead depend the outer-ring-of-spiral-wound-gasket side orbital plane formation member 412 at a shrink fitting etc. to the body member 411 of an outer ring of spiral wound gasket ] pressing fit. What is necessary is to carry out RF quenching or laser quenching to the inner skin (orbital plane) of the outer-ring-of-spiral-wound-gasket side orbital plane formation member 412, and just to machine after an appropriate time, after unifying both members in the case of cast.

[0045] On the other hand, what is necessary is just to unify the body member 411 of an outer ring of spiral wound gasket with forging to the outer-ring-of-spiral-wound-gasket side orbital plane formation member 412 which consists of an iron system material, when the body member 411 of an outer ring of spiral wound gasket is formed from the titanium alloy with a coefficient of linear expansion smaller than an iron system material. Adhesives may be applied to the joint of the member of the both sides in the case of forging. Moreover, the inner skin (orbital plane) of the outer-ring-of-spiral-wound-gasket side orbital plane formation member 412 may be beforehand stiffened by heat treatment, and may perform and stiffen RF quenching or laser quenching after junction of both members.

[0046] In addition, when the difference of the coefficient of linear expansion of the body member 411 of an outer ring of spiral wound gasket and the outer-ring-of-spiral-wound-gasket side orbital plane formation member 412 is 5x10 to less than six, both members can be cast and can be unified by junction by adhesives, such as forging, press fit, and an epoxy resin, etc.

[0047] Next, the joint approach of three components which constitute the inner ring of spiral wound gasket 42 is explained. First, when the inner-ring-of-spiral-wound-gasket body member 421 is formed from the titanium alloy, the inner-ring-of-spiral-wound-gasket side orbital plane formation member 421 concerned and the inner-ring-of-spiral-wound-gasket body member 422 can be unified casting the inner-ring-of-spiral-wound-gasket side orbital plane formation member 422 which consists of an iron system material with a titanium alloy, or by pressing the inner-ring-of-spiral-wound-gasket side orbital plane formation member 422 fit by a shrink fitting etc. to the inner-ring-of-spiral-wound-gasket body member 421. In this case, the peripheral face (orbital plane) of the inner-ring-of-spiral-wound-gasket side orbital plane formation member 422 is stiffened with RF quenching and laser quenching, and should just machine after an appropriate time.

[0048] On the other hand, what is necessary is just to unify the inner-ring-of-spiral-wound-gasket body member 421 with forging to the inner-ring-of-spiral-wound-gasket side orbital plane formation member 422 which consists of an iron system material, when the inner-ring-of-spiral-wound-gasket body member 421 is formed from the aluminium alloy. Moreover, it can also unify by press fit by a shrink fitting etc. Adhesives can also be used for the joint of both members in the case of forging and press fit. Moreover, the peripheral face (orbital plane) of the inner-ring-of-spiral-wound-gasket side orbital plane formation member 422 may be beforehand stiffened by heat treatment, and may be made to perform and harden RF quenching and laser quenching after junction.

[0049] In addition, when the difference of the coefficient of linear expansion of the inner-ring-of-spiral-wound-gasket body member 411 and the inner-ring-of-spiral-wound-gasket side orbital plane formation member 412 is 5x10 to less than six, both members can be cast and can be unified by junction by adhesives, such as forging, press fit, and an epoxy resin, etc.

[0050] Next, association with the inner-ring-of-spiral-wound-gasket body member 411 and the tooth part formation member 512 of the rigid internal gear 51 as well as the case in the above-mentioned outer ring of spiral wound gasket can be performed.

[0051] In order to raise the bond strength of the component part of the outer ring of spiral wound gasket 41 which is composite part, and an inner ring of spiral wound gasket 42 here, the thing which receive in

the direction of an axis, a circumferencial direction, or the direction of both to each part article combined and which it escapes and is established for the irregularity for stops is desirable. Moreover, as for the thickness of the part in which the orbital plane in the outer-ring-of-spiral-wound-gasket side orbital plane formation member 412 in which the orbital plane is formed, and the inner-ring-of-spiral-wound-gasket side member 422 in a circle is formed, it is desirable to consider as 1/5 or more dimensions of the diameter of the koro 43.

[0052] (annular member for bolt bearing surfaces) In this example, conclusion immobilization of the body member 411 of an outer ring of spiral wound gasket is carried out with the bolt for conclusion at the 1st end plate 2 side. If the bearing surface of the bolt of the bolt for conclusion is made into the annular end face 415 of the body member 411 of an outer ring of spiral wound gasket which consists of a light-weight material, when the seat planar pressure of a bolt is high, by the reinforcement of a light alloy, it may be insufficient. Then, he arranges the annular plate 9 which consists of an iron system material to the annular end face 415 of the body member 411 of an outer ring of spiral wound gasket which becomes with a bolt bearing surface beforehand, and is trying for the front face of the annular plate 9 concerned to turn into a bolt bearing surface like [ the above ] in this example.

[0053] Moreover, in this example, it has considered as the configuration which attached oil seal 91 in the inner circumference edge of the annular plate 9 arranged in order to form a bolt bearing surface. Consequently, since oil seal is also formed in coincidence by attaching the annular plate 9, the device for the activity for attaching oil seal becoming unnecessary, and attaching oil seal also becomes unnecessary.

[0054] The [2nd example], next drawing 2 are the sectional views of the wave-motion gearing unit equipped with the cup mold wave-motion gearing which applied this invention. This wave-motion gearing unit 100 had wave-motion gearing 110, and this wave-motion gearing 110 is equipped with the annular rigid internal gear 120 with which the internal tooth 123 is formed in inner skin, the flexible external-tooth gearing 130 of a cup mold stationed at this inside, and the wave-motion generator 140 inserted in this inside. Moreover, the wave-motion gearing unit 100 has the cloth roller bearing 150 which has connected the rigid internal gear 110 and the flexible external-tooth gearing 120 in the condition in which relative rotation is free.

[0055] The rigid internal gear 120 is composite part which consists of a cylinder-like gearing body member 121 and a tooth part formation member 122 of the shape of a circular ring currently united with the inner skin by the side of the end of this gearing body member 121, and the internal tooth 123 is formed in the inner skin of this tooth part formation member 122.

[0056] The flexible cup-like external-tooth gearing 130 has the cylinder-like drum section 131, the external tooth 132 formed in the peripheral face of the opening edge of one of these, the annular diaphram 133 which is following the opening edge of another side of a drum section 131, and the heavy-gage annular boss 134 who is following this diaphram 133.

[0057] As for the wave-motion generator 140, the boss 143 with which a motor output shaft (not shown) etc. is connected is formed in the rigid cam plate 141 equipped with the profile of an ellipse form, the ball bearing 142 put on the periphery, and the core of the rigid cam plate 141.

[0058] The cloth roller bearing 150 has an outer ring of spiral wound gasket 151, an inner ring of spiral wound gasket 155, and two or more koro 160 inserted in the annular orbit formed among these. An outer ring of spiral wound gasket 151 is composite part which consists of a circular ring-like body member 152 of an outer ring of spiral wound gasket, and an outer-ring-of-spiral-wound-gasket side orbital plane formation member 153 of the shape of a circular ring combined with this inside, and V-like orbital plane is formed in the inner skin of the outer-ring-of-spiral-wound-gasket side orbital plane formation member 153. Conclusion immobilization of the outer ring of spiral wound gasket 151 of this configuration is carried out with the bolt 154 for conclusion at the annular end face of the rigid internal gear 120.

[0059] An inner ring of spiral wound gasket 155 is composite part which consists of a heavy-gage disc-like inner-ring-of-spiral-wound-gasket body member 156 and an inner-ring-of-spiral-wound-gasket side orbital plane formation member 157 of the shape of a circular ring combined with this peripheral face, and V-like orbital plane is formed in the peripheral face of this inner-ring-of-spiral-wound-gasket side

orbital plane formation member 157. Conclusion immobilization of the inner ring of spiral wound gasket 155 of this configuration is carried out with the conclusion bolt 158 at the flexible external-tooth gearing's 130 boss 134, and driven flank material (not shown) is connected with the outside end face of the inner-ring-of-spiral-wound-gasket body member 156 of the inner ring of spiral wound gasket concerned.

[0060] Moreover, also in this example, the annular plate 170 for forming a bolt bearing surface in the annular end face of the body member 152 of an outer ring of spiral wound gasket is arranged. Furthermore, oil seal 171 is attached in the inner circumference edge of the annular plate 170 concerned, and between an outer ring of spiral wound gasket and inner rings of spiral wound gasket is made into the seal condition with this oil seal 171.

[0061] Also in the wave-motion gearing unit 100 of this example, the outer ring of spiral wound gasket 151 which is composite part, the inner ring of spiral wound gasket 155, and the rigid internal gear 120 are constituted by the components which consist of the same material as the above-mentioned example. That is, the outer-ring-of-spiral-wound-gasket side orbital plane formation member 153 for which endurance, abrasion resistance, etc. are needed, the inner-ring-of-spiral-wound-gasket side orbital plane formation member 157, and the tooth part formation members 122 of a rigid internal gear are the components formed from the iron system material. On the other hand, the body member 152 of an outer ring of spiral wound gasket, the inner-ring-of-spiral-wound-gasket body member 156, and the gearing body members 121 are the components formed from light-weight materials, such as a light alloy. The joint approach of such each part articles can adopt the same approach as the 1st above-mentioned example. Moreover, the part of the rigid cam plate 141 of the wave-motion generator 140 can also be formed from a light-weight material.

[0062] Although the above-mentioned example which is [the gestalt of other operations] is related with a wave-motion gearing unit, this invention is applicable similarly to a cloth roller bearing simple substance. That is, in the cloth roller bearing in each above-mentioned example, if a thing without a tooth part formation member is used as a bearing in the units, for example, the epicyclic gear reducer unit etc., other than a wave-motion gearing unit etc., lightweight-ization of the whole unit is realizable.

[0063]

[Effect of the Invention] As explained above, at the cloth roller bearing of this invention, the body part of an outer ring of spiral wound gasket and an inner-ring-of-spiral-wound-gasket body part were formed from the light-weight material, only the parts of the outer-ring-of-spiral-wound-gasket side orbital plane for which reinforcement is needed, and an inner-ring-of-spiral-wound-gasket side orbital plane were formed from the iron system material, and the configuration which combined these members and was unified is adopted. Therefore, according to this invention, very lightweight cloth roller bearing is realizable.

[0064] On the other hand, in the wave-motion gearing unit of this invention, the body part of an outer ring of spiral wound gasket and inner-ring-of-spiral-wound-gasket body part of cloth roller bearing which occupy the fault half part of the weight were formed from the light-weight material, only the parts of the outer-ring-of-spiral-wound-gasket side orbital plane for which reinforcement is needed, and an inner-ring-of-spiral-wound-gasket side orbital plane were formed from the iron system material, and the configuration which combined these members and was unified is adopted. Therefore, while according to this invention it is small and compact, a very lightweight wave-motion gearing unit is realizable.

[0065] Moreover, in this invention, in addition to the above-mentioned configuration, the gearing body part of the rigid internal gear which occupies the fault half part of the weight of wave-motion gearing was formed with the light-weight material, only the internal-tooth part for which reinforcement is needed was formed from the material of an iron system, and the configuration which combined these members and was unified is adopted. Therefore, a very lightweight wave-motion gearing unit is realizable.

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[Translation done.]

* NOTICES *



## CLAIMS

[Claim(s)]
[Claim 1] In the cloth roller bearing by which the fixed hole or tap for conclusion to other members is formed in the outer ring of spiral wound gasket and the inner ring of spiral wound gasket said outer ring of spiral wound gasket It has the body member of an outer ring of spiral wound gasket in which said fixed hole or tap was formed, and the outer-ring-of-spiral-wound-gasket side orbital plane formation member by which the orbital plane is formed in inner skin while being fixed to the inner skin of this body member of an outer ring of spiral wound gasket. The inner-ring-of-spiral-wound-gasket body member in which, as for said inner ring of spiral wound gasket, said fixed hole or tap was formed, It has the inner-ring-of-spiral-wound-gasket side orbital plane formation member by which the orbital plane is formed in the peripheral face while being fixed to the peripheral face of this inner-ring-of-spiral-wound-gasket body member. Two or more koro is inserted into the orbit by which partition formation is carried out between said outer-ring-of-spiral-wound-gasket side orbital plane formation member and an inner-ring-of-spiral-wound-gasket side orbital plane formation member. Said outer-ring-of-spiral-wound-gasket side orbital plane formation member and an inner-ring-of-spiral-wound-gasket side orbital plane formation member are cloth roller bearing characterized by being formed from the iron system material and forming said body member of an outer ring of spiral wound gasket, and the inner-ring-of-spiral-wound-gasket body member from the light-weight material lighter than said iron system material.
[Claim 2] It is the cloth roller bearing characterized by said light-weight material being the alloy of light metals, such as an aluminium alloy and a titanium alloy, plastics, or a ceramic in claim 1.
[Claim 3] It is the cloth roller bearing characterized by unifying the outer-ring-of-spiral-wound-gasket side orbital plane formation member concerned and said body member of an outer ring of spiral wound gasket by casting said outer-ring-of-spiral-wound-gasket side orbital plane formation member which said body member of an outer ring of spiral wound gasket is formed from the aluminium alloy in claim 1, and consists of an iron system material with an aluminium alloy, or press fit according an outer-ring-of-spiral-wound-gasket side orbital plane formation member to a shrink fitting etc. to said body member of an outer ring of spiral wound gasket.
[Claim 4] It is the cloth roller bearing characterized by said body member of an outer ring of spiral wound gasket being unified by forging to said outer-ring-of-spiral-wound-gasket side orbital plane formation member which said body member of an outer ring of spiral wound gasket is formed from the titanium alloy in claim 1, and consists of an iron system material.
[Claim 5] It is the cloth roller bearing characterized by unifying the inner-ring-of-spiral-wound-gasket side orbital plane formation member concerned and said inner-ring-of-spiral-wound-gasket body member by casting said inner-ring-of-spiral-wound-gasket side orbital plane formation member which said inner-ring-of-spiral-wound-gasket body member is formed from the titanium alloy in claim 1, and consists of an iron system material with a titanium alloy, or press fit according an inner-ring-of-spiral-wound-gasket side orbital plane formation member to a shrink fitting etc. to said inner-ring-of-spiral-wound-gasket body member.
[Claim 6] It is the cloth roller bearing characterized by said inner-ring-of-spiral-wound-gasket body

member being unified by forging to said inner-ring-of-spiral-wound-gasket side orbital plane formation member which said inner-ring-of-spiral-wound-gasket body member is formed from the aluminium alloy in claim 1, and consists of an iron system material.

[Claim 7] Cloth roller bearing characterized by attaching in the annular end face of said body member of an outer ring of spiral wound gasket the annular plate for bolt bearing surfaces which consists of an iron system material in claim 1.

[Claim 8] Cloth roller bearing characterized by attaching in the annular plate for said bolt bearing surfaces the oil seal which blocks between said outer ring of spiral wound gasket and inner rings of spiral wound gasket in claim 7.

[Claim 9] A rigid internal gear, the flexible external-tooth gearing stationed at this inside, and the wave-motion generator arranged at this inside, In the wave-motion gearing unit which has the cloth roller bearing which has connected said rigid internal gear and said flexible external-tooth gearing in the condition in which relative rotation is free The outer-ring-of-spiral-wound-gasket side orbital plane formation member by which the orbital plane is formed in inner skin while said cloth roller bearing is being fixed to the inner skin of the body member of an outer ring of spiral wound gasket, and this body member of an outer ring of spiral wound gasket, An inner-ring-of-spiral-wound-gasket body member and the inner-ring-of-spiral-wound-gasket side orbital plane formation member by which the orbital plane is formed in the peripheral face while being fixed to the peripheral face of this inner-ring-of-spiral-wound-gasket body member, It has two or more koro inserted into the orbit by which partition formation is carried out between said outer-ring-of-spiral-wound-gasket side orbital plane formation member and an inner-ring-of-spiral-wound-gasket side orbital plane formation member. Said outer-ring-of-spiral-wound-gasket side orbital plane formation member and an inner-ring-of-spiral-wound-gasket side orbital plane formation member are a wave-motion gearing unit characterized by being formed from the iron system material and forming said body member of an outer ring of spiral wound gasket, and the inner-ring-of-spiral-wound-gasket body member from the light-weight material lighter than said iron system material.

[Claim 10] It is the wave-motion gearing unit characterized by equipping said rigid internal gear with the gearing body member and the tooth part formation member of the shape of a circular ring by which the internal tooth is formed in inner skin while being fixed to the inner skin of this gearing body member in claim 9, forming said tooth part formation member from the iron system material, and forming said gearing body member from the light-weight material lighter than said iron system material.

[Claim 11] It is the wave-motion gearing unit which is equipped with the ball bearing which inserted said wave-motion generator in the peripheral face of a rigid cam plate and this rigid cam plate in claim 9, and is characterized by forming said rigid cam plate from the light-weight material lighter than an iron system material.

[Claim 12] It is the wave-motion gearing unit characterized by said light-weight material being the alloy of light metals, such as an aluminium alloy and a titanium alloy, plastics, or a ceramic in claim 9 thru/or which term of 11.

[Claim 13] It is the wave-motion gearing unit characterized by unifying the outer-ring-of-spiral-wound-gasket side orbital plane formation member concerned and said body member of an outer ring of spiral wound gasket by casting said outer-ring-of-spiral-wound-gasket side orbital plane formation member which said body member of an outer ring of spiral wound gasket is formed from the aluminium alloy in claim 9, and consists of an iron system material with an aluminium alloy, or press fit according an outer-ring-of-spiral-wound-gasket side orbital plane formation member to a shrink fitting etc. to said body member of an outer ring of spiral wound gasket.

[Claim 14] It is the wave-motion gearing unit characterized by said body member of an outer ring of spiral wound gasket being unified by forging to said outer-ring-of-spiral-wound-gasket side orbital plane formation member which said body member of an outer ring of spiral wound gasket is formed from the titanium alloy in claim 9, and consists of an iron system material.

[Claim 15] It is the wave-motion gearing unit characterized by unifying the inner-ring-of-spiral-wound-gasket side orbital plane formation member concerned and said inner-ring-of-spiral-wound-gasket body

member by casting said inner-ring-of-spiral-wound-gasket side orbital plane formation member which said inner-ring-of-spiral-wound-gasket body member is formed from the titanium alloy in claim 9, and consists of an iron system material with a titanium alloy, or press fit according an inner-ring-of-spiral-wound-gasket side orbital plane formation member to a shrink fitting etc. to said inner-ring-of-spiral-wound-gasket body member.

[Claim 16] It is the wave-motion gearing unit characterized by said inner-ring-of-spiral-wound-gasket body member being unified by forging to said inner-ring-of-spiral-wound-gasket side orbital plane formation member which said inner-ring-of-spiral-wound-gasket body member is formed from the aluminium alloy in claim 9, and consists of an iron system material.

[Claim 17] It is the wave-motion gearing unit characterized by unifying the tooth part formation member concerned and said gearing body member by casting said tooth part formation member which said gearing body member is formed from the aluminium alloy in claim 10, and consists of an iron system material with an aluminium alloy, or press fit according a tooth part formation member to a shrink fitting etc. to said gearing body member.

[Claim 18] It is the wave-motion gearing unit characterized by said gearing body member being unified by forging to said tooth part formation member which said gearing body member is formed from the titanium alloy in claim 10, and consists of an iron system material.

[Claim 19] The wave-motion gearing unit characterized by attaching in the annular end face of said body member of an outer ring of spiral wound gasket the annular plate for bolt bearing surfaces which consists of an iron system material in claim 9.

[Claim 20] The wave-motion gearing unit characterized by attaching in the annular plate for said bolt bearing surfaces the oil seal which blocks between said outer ring of spiral wound gasket and inner rings of spiral wound gasket in claim 19.

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